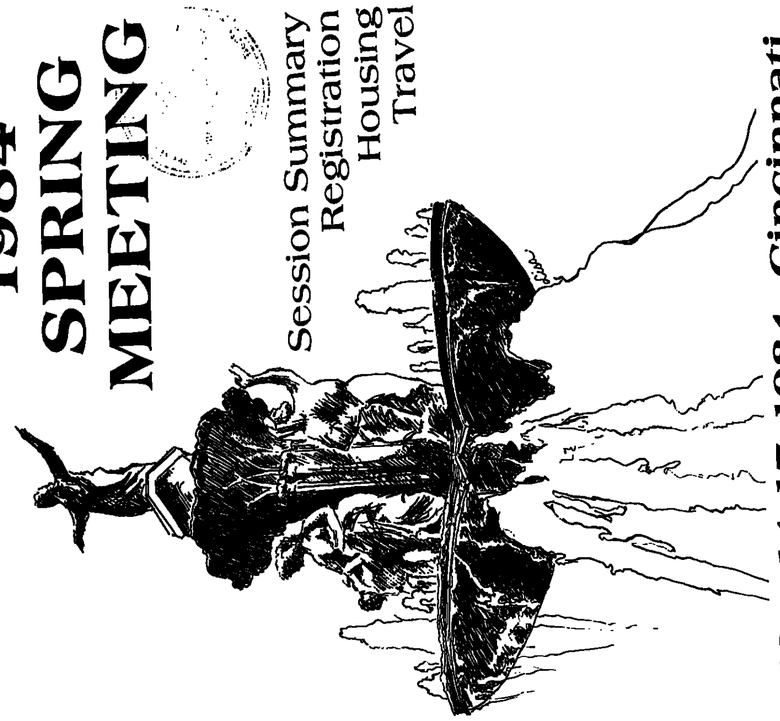
EOS

Transactions, American Geophysical Union
Vol. 65 No. 13 March 27, 1984

1984 SPRING MEETING

Session Summary
Registration
Housing
Travel



May 14-17, 1984, Cincinnati

Eos, Transactions, American Geophysical Union Vol. 65, No. 13, Pages 113–128 March 27, 1984

Volcanology

8699 Volcanology (Ash Composition)
SULFUR MONITOR CONTENT OF RECENT ST. HELENS' ASH
C. J. Wuechler (Bell Laboratories, Holmdel, New Jersey, 07733)

Surprisingly large amounts of sulfur dioxide evolve from rapidly heated samples of Mt. St. Helens' ash. The sulfur dioxide has been detected and quantified using rapid heating-gas chromatography-mass spectrometry. Ash samples from the May 18, 1980, eruption collected at Hoses Lake, Missoula, and Kelsaya produced average quantities of sulfur dioxide corresponding to 215, 270, and 1250 ppm, respectively. Similarly, as the distance of the collection point from Mount St. Helens increases, the ratio of new cognatic ash to old mountain material increases. This suggests that the SO_2 is derived primarily from new magmatic material. Experiments indicate that sulfur dioxide is not due to surface species scavenged from the eruption plume or to sulfur gases adsorbed on the ash. Other possible sources include reduction of sulfate salts within the ash, bubbles of SO_2 trapped within the ash, or sulfur blebs contained in the ash. Approximately as much sulfur dioxide or sulfur dioxide precursors are associated with the ash as Mount St. Helens injected into the stratosphere. (Volcanic ash, ash composition).
J. Geophys. Res., D, Paper 4D0362

8699 Volcanology (Calderas)
PERALKALINE ASH-FLOW TUFFS AND CALDERAS OF THE MCDERMITT VOLCANIC FIELD, SOUTHEAST OREGON AND NORTH-CENTRAL NEVADA
J. J. Rytuba (U.S. Geological Survey, Menlo Park, CA 94025), E. H. McKee

The McDermitt volcanic field covers an area of 20,000 km^2 in southeastern Oregon and northwestern Nevada and consists of seven large volcanic ash-flow sheets which erupted from 16.1 to 15 Ma ago. The volcanic field is characterized by peralkaline, high-silica rhyolite, and all but one of the sheets are comendites. The ash-flow tuff sheets in a 1.5-km-thick section of Miocene Steens volcanic series and Steens Basalt, indicating a minimum age of 16.1 Ma for the Steens Basalt. The Quemado cliff, a 200-km-long NNE-striking structure, developed just prior to eruption of the oldest lavas. Each ash-flow sheet resulted in the formation of a large collapse caldera along the Quemado rift. The center of the volcanic field is dominated by four overlapping and nested calderas; satellitic to these are three additional calderas. The areas adjacent to the incipient calderas subsided during ash-flow eruption. Thickening of the ash-flow sheets, monoclinal warping outside the caldera ring fault, and tilting in toward the caldera of blocks bounded by curvilinear faults all indicate regional subsidence prior to caldera collapse. The McDermitt caldera complex is highly mineralized; it contains ore deposits of Hg, Sb, Cu, Li, and U. The peralkaline tuffs have high contents of these elements and were the source rocks from which metals were leached by hydrothermal systems developed during the last stage of caldera-related volcanism. (Calderas, ash-flow tuffs)
J. Geophys. Res., B, Paper 4B0159

8699 Volcanology Topics (Calderas)
EVOLUTION OF THE EARLY OLIGOCENE ROWANDA CALDERA, NORTHEAST SAN JUAN VOLCANIC FIELD, COLORADO
R. J. Varga and R. B. Smith (Texas Oil Research Center, P.O. Box 70, Bryan, Calif., 92017)

The 35 Ma Rowanda caldera developed within a slightly older sequence of intermediate-composition volcanics (Hinsley Andesite), equivalent to the Conejos Formation of the greater San Juan volcanic field. Vent-facies lava flows, monolithic breccias and numerous intrusions dominate the early sequences within and near the caldera. Distal lava flows and abundant lahars of Hinsley Andesite dip radially outward, suggesting that the Rowanda caldera formed near the summit of a large composite volcano. The caldera collapsed in a trapdoor fashion when 700 km³ of dacite and rhyolite ignimbrite of the Rowanda Tuff erupted from a melt zone near or over the NNW caldera margin. Distric normal faulting along a western ring fault system dropped basal ignimbrites down to the east with a maximum displacement of nearly 1 km. Pre-existing basement structures may have influenced the orientation of the ring fault system. Andesite and dacite lava flows overlie the Rowanda Tuff, marking a return to massive volcanism following explosive eruptions. Slightly younger silicic stocks and exogenous rhyolite domes were emplaced along the caldera margins and were cut by ring fracture faults, suggesting a protracted history of caldera collapse. Hinsley Andesite, lower Rowanda Tuff and late lava flows are chemically similar high-K andesites and dacites. Initial Sr (87/86) ratios (0.70529–0.70688) of the intermediate units preclude major assimilation of radiogenic Precambrian upper crust. The compositional homogeneity of these rocks and the absence of Plinian fallout components in the ignimbrites suggest that subvolcanic magma chambers at Rowanda did not become strongly compositionally zoned. Rhyolite ignimbrite of the upper Rowanda Tuff (initial Sr (87/86) = 0.70450) may be transitional petrochemically with lithic, silicic rocks, rather than with the volcano-building andesitic suite. The Rowanda caldera appears to be closely related to two Oligocene calderas to the north (Mt. Aetna and Grizzly Peak), which share a common portion along the western edge of the northern Rio Grande rift system. Early Oligocene silicic magmatism and caldera formation along this trend may mark the initial phases of rift evolution, perhaps heralding a change to a tensional stress regime prior to physiographic development of the rift valley. (Calderas, stratigraphy, geochronology, Colorado).
J. Geophys. Res., B, Paper 4B0251

8699 Volcanology (Calderas)
LOCATION AND CONFIGURATION OF MAGMA BODIES BENEATH LONG VALLEY, CALIFORNIA, DETERMINED FROM ANOMALOUS EARTHQUAKE SIGNALS
Chris O. Sanders (Seismological Laboratory, Mackay School of Mines, University of Nevada, Reno, Nevada, 89557)

Recordings of 281 small earthquakes which occurred recently near the southern edge of Long Valley caldera at depths from 1 to 15 km were used to map the subsurface geometry of shear-wave attenuating bodies in the caldera. Signatures of these events recorded northwest, north, northeast, and east of Long Valley with ray paths through the caldera are often anomalous in that S-wave arrivals have very low amplitudes, and high frequency P- and S-wave energy is missing for the same stations-event combinations. The volcanic and geothermal history of the region suggests that ray paths for these anomalous signals have passed through magma which absorbed much of the S-wave energy and also attenuated the higher frequencies. With over 1200 normal and anomalous ray paths through the caldera we have located two massive magma bodies in the central and northwest caldera as well as two apparently dispersed magma areas in the southern caldera and beneath Crowley Lake. The central magma body extends from 4.5 to at least 13 km beneath the surface and the northwest body is as shallow as 5.5 km. These two magma bodies are probably connected below about 8 km. Secondary arrivals seen on select seismograms are tentatively interpreted as reverberations inside the central magma chamber and are consistent with the interpreted lateral extent of the magma. The northwest and central magma bodies lie beneath the northwest and southeast corners of the caldera's resurgent dome and probably connect beneath the dome's center. Also the shallower parts of these magma bodies and the southern anomalous area lie beneath the surface expression of the medial graben faults suggesting that structural features seen at the surface of the valley may be related to magma location at depth.
J. Geophys. Res., B, Paper 4B0212

8699 Volcanology Topics
CALDERA VOLCANOES OF THE TAUPO VOLCANIC ZONE, NEW ZEALAND
C.J.N. Wilson (Geology Dept., Auckland University, Private Bag, Auckland, New Zealand), A.M. Hogan, I.E.M. Smith, D.J. Northey, I.A. Nairn, and B.F. Houghton

The Taupo Volcanic Zone (TVZ) has been active since 2Ma and has erupted >10³ km³ of dominantly rhyolitic magma during the last 1 million years. Most of this volcanism is concentrated in a 120 x 60km area forming the Central TVZ and is expressed largely as 25 major Ongatiki, Rotoa and Taupo, marked by localized collapse of the underlying basement and clustered activity spans from 340 to 600ka and have each produced at least 300 to 1000km³ of magma. All centers over features are known or inferred to have had complex histories of multiple caldera collapse, which has occurred alongside general basement collapse within the TVZ accompanying regional extension. Deep seated NE-trending basement lineations and/or faults have influenced vent sites at Okataina, Rotoa and Taupo. Welded ignimbrites are prominent in the pre-40ka record; their absence since then is attributed to the effects of surface water on eruption styles rather than to a change in eruptive behavior. Volcanism from the centers has been overwhelmingly rhyolitic (>95% by 60-77 wt.%) with minor high-Al basalt and dacite, rare traces of andesites, mostly as lithic fragments in rhyolite ignimbrite from Okataina and Mangakino. Although insignificant in volume, the basalt is important as a low-Si end-member in mixing relationships with the rhyolite (at one extreme generating the dacites) and occasionally as a trigger for the rhyolitic eruptions. The current average rhyolite magma eruption rate for the central TVZ is $c.0.2 km^3 a^{-1}$, equally divided between Okataina and Taupo, a figure close to the long term average for the last 1.1Ma. However, geothermal heat flow data imply that a further 1.4-1.8km³ a⁻¹ of magma may be intruded within the crust. The ratio of magma intruded material to erupted material is higher at centers where lava extrusions are volumetrically significant (Okataina, Maroa) and this is correlated with lower phenocryst equilibration temperatures and fewer eruptives. Evidence for resurgent doming and long-term (>10³ years) magma cycles documented at similarly large rhyolitic calderas in the western USA is absent from the TVZ centres; this is attributed to the young, faulted crust of the region preventing the formation of sufficiently large high-level magma chambers. In overall terms, the central TVZ is comparable in size and longevity to the Yellowstone system, but its individual eruptions have very much shorter recurrence intervals and smaller volumes. (Calderas, low-silica rhyolites, Quaternary volcanism).
J. Geophys. Res., B, Paper 4B0128

8699 Volcanology Topics
TERTIARY ISHIKUCHI CALDERON, SOUTHWESTERN JAPAN AND FORMATION BY RING-FRACTURE SUBSIDENCE
Yoshiki Ishikuchi (Institute of Mineralogy, Petrology and Economic Geology, Tohoku University, Sendai, Japan)

The Tertiary Ishikuchi caldera in northeastern Shikoku volcanic belt of Miocene age is 7-8 km in diameter and included outer and inner ring fractures, inward-dipping conjugate, radial normal faults, and ring-dike complexes. Andesitic to dacitic welded tuffs within the central caldera basin demonstrate repeated explosive activity during subsidence of the cauldron. Inward dips of ring fractures surrounding the caldera and of upward-bounding faults have the shape of an upward-pointing cone. The cone shape is substantiated by detailed mapping of intrusive welded tuffs developed along the outer and inner ring faults. The ring-fracture complexes consist of rhyolite to andesite ring dikes, as well as intrusive tuffs and breccias, which some of the adjacent pyroclastic volcanic deposits were probably erupted. Coeval andesite porphyritic granodiorite and fine-grained granophyre were intruded into the 14 Ma caldera. Inward-dipping outward and flat roofs, and may have developed from upward cupolar bodies which may connect downward to dikes and sheeted intrusive complexes. Detailed study of fracture pattern from the margin of the caldera to the opposite-upward fracture inside the caldera, and intrusive textures ranging from vertical to horizontal, and release of pressure from the magma chamber during caldera collapse. Many volcanic rocks in the caldera, particularly dacitoids are located in the same direction of the paleomagnetic declination of regional origin is parallel to arc structures in the middle Miocene southwestern Japan arc. Ring fractures, ring dikes, cone sheets, cupolar bodies, caldera collapse, resurgent doctrine, Miocene field relations). J. Geophys. Res., B, Paper 4B0251

News

Dechlorination

Dechlorination is a waste water treatment process used by water treatment plants and power plants as a measure to meet "...increasingly stringent discharge limitations." (*Environ. Sci. Technol., 18*, 48A-55A, 1984). Chlorination is used to kill bacteria and to reduce algae in waste water, but chlorine-rich waters discharged from the treatment and power plants can kill fish and wildlife as well. Damages to the marine ecosystem as the result of chlorination were focused upon in a series of studies 2 years ago (*Environ. Sci. Technol., 16*, 13A-18A, 1982). Now, as was pointed out by geochemists G. R. Helz and L. Kosak-Channing of the University of Maryland, "...questions remain about the environmental effects of the general use of dechlorination." (*Environ. Sci. Technol., 18*, 48A-55A, 1984). If the dechlorination steps are not thorough, toxic effects of a lower but still serious level may ensue.

Helz and Kosak-Channing note that dechlorination is being carried out at a dozen facilities in California and at about 50 waste water treatment plants in Maryland. Dechlorinating agents employed include activated graphite, hydrogen peroxide, sodium thiosulfate, and several SO_2-yielding compounds. They note that better control of SO_2 application is needed. The effectiveness of the process as well as evaluation of sublethal effects can be determined only by better analytical methods than are now being used.

It will be important to study the effects of the continuous release of SO_2 compounds downstream. The manner by which trace metals are compounded and their persistence needs to be evaluated. Unfortunately, it is the more subtle long-term effects on natural waters that cannot be known in advance that could be most pervasive.—*PMB*

Lunar Core: Occam's Razor?

Whether or not the earth's moon has a core is a much bandied question. Like many notions about the properties of the moon, ideas of a lunar core changed drastically after the Apollo studies. A review of the development of these ideas was given a scholarly treatment by S. K. Runcorn recently (*Nature, 304*, 589–596, 1983). In contrast, L. L. Hood, C. P. Sonett, and L. J. Suika have questioned the concept in serious detail (*Nature, 307*, 661–662, 1984).

Whether or not the moon actually has or has had a fluid metallic core is of great consequence for a number of geophysical theories about the solar system. Most investigators concede that the possible existence of a lunar core remains one of the major unanswered, and yet most critical, questions about the moon. A lot rides on the answer: Can a lunar-sized body have a core? Is the core metallic? How is the core related to lunar magnetism and its paleomagnetism? Is or was a lunar core related to lunar volcanism? If the moon can have a core, is planetary core formation in the solar system a simple matter of gravitationally segregating metallic fragments that were formed elsewhere? Implications of the questions are without limit. There is, perhaps, no more valid issue about the moon to explore scientifically.

The question of a lunar core is associated with a number of subtly perplexing phenomena. Note that the moon has no "normal" dipole field. The most sensitive instruments ever assembled detected no field and no minor components. The moon has small central pressures (approximately 50 x 10^8 Pa), and thus would probably not have formed a core; the pressure-temperature regime would be unique if it did. This picture prevailed until actual measurements were made by Apollo astronauts on the moon's surface and by Apollo scientists on returned lunar samples. Lunar surface rocks have strong remnant and residual magnetic components, the orientations of which carry no evidence of the source of their magnetism. But, the rocks must have seen a strong magnetic field, their magnetic orientation otherwise would have been destroyed by the effects of meteorite bombardment of the moon's surface.

As the data on lunar rocks improved, a number of new theories rose and fell in popular support. The explanations range widely. The moon could, for example, have been exposed in its early history to a strong intergalactic magnetic field. Magnetic effects could have been induced in lunar surface rocks somehow as the result of shock waves caused by meteorite impact. One idea that had to be tested was that lunar samples may have been magnetized, in part, by fields present in the Apollo spacecrafts on their return to earth. The tests actually involved carrying magnetically stripped lunar samples back to the moon.

An obvious line of reasoning to explain the observed magnetism of the lunar crust that would be consistent with the present-day absence of a lunar magnetic field, was to postulate the existence of an ancient core dynamo. It was thought that geophysical measurements should be able to establish whether or not a fossil-cooled lunar metallic core sufficient to have produced the field exists. Seismic data presumably would have been sufficient. Unfortunately, the lunar seismometer had to be turned off, prematurely some believe, because of funding cutbacks in the Apollo program. Since then, assembled geophysical data, seismic, gravity, electrical field, heat flow, and other types, seem to indicate the possible existence of a 1000-km-diameter solid metallic core. The data do not require the existence of a core, but a core model would not be in violation of the evidence.

The answer to the lunar core question is not at hand, although an immense gain in the understanding of planetary magnetism has been made. Runcorn's review supports the core theory. Hood et al. challenge the theory on reasonable grounds. Runcorn, then, resorted to a more philosophical approach: "That Hood et al. consider my account as 'somewhat misleading' can only mean that they do not appreciate that even though each line of evidence is not conclusive the fact that all point to the existence of a lunar core lends much greater weight to the hypothesis than any one line could." To support this principal of reasoning Runcorn calls upon "Occam's Razor" as a model. Students of 14th century philosophy will also recall, however, that William of Occam was a skeptic, having been accused of heresy by the Chancellor of Oxford in 1323!

There are a number of scientifically sound reasons for returning to the moon. Perhaps when geophysical apparatus is again installed on the lunar surface enough will be known about the Apollo samples, galactic fields, impact-shock induced magnetic-electrical field phenomena, lunar magnetic anomalies, planetary dynamics, and core-dynamic theory to provide the basis for critical measurements to answer the lunar core question.—*PMB*

Editorial

AGU Committees: An Opportunity to Serve

Responsibility for the administration of AGU lies with its Council, and the Council depends heavily on advice from its committees. *AGU* committees bear heavy responsibilities and have significant stature in the Union. Every committee chairman is invited to participate actively in Council meetings and to take part in a biennial planning session. Few items come before the Council without first having been studied thoroughly by one or more committees; those that don't come to the Council from a committee usually fail or are remanded for future study.

Service on a committee is one of the best ways that AGU members can become involved in the activities of AGU and help shape its future. All committees expire at the end of the President's 2-year term. While some committee members will be reappointed in the interest of preserving continuity and experience, many new members will be appointed to bring in new blood and new ideas. As incoming President I have the responsibility for putting together the rosters for AGU committees over the next few months. To do this properly, I need your help.

If you wish to serve the Union as a committee member, or if you wish to nominate someone to serve, please write to me at AGU Headquarters. Please indicate which of the committees listed below relates to your interest or your nomination and what special thoughts you or your nominee might bring to the committee. I look forward to serving the Union with many of you and to recommending to my successor that careful consideration be given to those whose interests cannot be accommodated at this time. AGU is its membership and depends upon its membership for its future; please let me hear from you now if you would like to help shape this future.

Charles L. Drake
President-Elect

Committee Responsibilities

Committee on Budget and Finance

Responsible for development of the annual budget, monitoring performance against the established budget, and reviewing developments that affect the financial health of the Union, as well as making recommendations on investment policy.

Committee on International Participation

Develops AGU policy on Union participation in international organizations and concerns itself with the interest of non-U.S. members in AGU.

Publications Committee

Has oversight of the entire publications program of AGU. Operating under the Publications Committee are the following Boards:

Books Board: Critically reviews the entire books program and coordinates the activities of the various series boards, which are the Antarctic Research Series Board, the Geophysical Monograph Board, and the Water Resources Monograph Board. The series boards are charged specifically with soliciting and developing manuscripts for books and with the critical review of submitted materials.

Journals Board: Responsible for continuing review of the journals program, including all of the regularly issued serial publications of the Union. Under their purview come timeliness of publication, the need and ability to respond to innovations in information dissemination and opportunities for expanding and improving the journals program.

Translations Board: Reviews proposals for translation and publication of foreign language books and journals, and retains oversight of the ongoing journal translation program.

Committee on Statutes and Bylaws

Assures that the statutes and bylaws of the Union are up-to-date and responsive to the needs of the membership.

Meetings Committee

Maintains a continuing review of AGU's entire meetings program and recommends policies related to meetings as well as new programs.

Committee of Fellows

Elects new Fellows and, through its various subcommittees, recommends medalists and awardees. All members of the Committee of Fellows must be Fellows of the Union. Customarily, but not always, one member represents each Section. Under the Committee of Fellows there are the following subcommittees, each of which is chaired by a member of the Committee of Fellows: Bowie Medal, Bucher Medal, Ewing Medal, Fleming Medal, Horton Medal, Macelwane Award, and External Awards.

Members of the subcommittees need not be Fellows of the Union.

Membership Committee

This Committee is in a state of reorganization. It will possibly be divided into a long-range planning committee and a membership committee primarily concerned with the recruitment and retention of members.

Council Committee on Financial Resources

A fund-raising committee intended to provide leadership and policy direction. Operating under the Council Committee is a steering committee which is implementing the GIFT fund drive, and under the steering committee is a subcommittee on corporate supporting membership.

Nominations Committee

Proposes candidates for Union office.

Committee on Education and Human Resources

Concerned with attracting good students into geophysics, and educational and employment opportunities.

Public Affairs Committee

Charged with providing effective mechanisms by which members of AGU can contribute their expertise to the solution of societal problems relating to geophysics. There are two subcommittees: (1) Government and Legislative Affairs, which serves as the Selection Committee for the AGU Congressional Fellow and assists the Public Affairs Committee by reviewing and developing any programs referred to it; and (2) Public Information, which supports press relations activities.

Audit and Legal Affairs Committee

This committee of Council members has responsibility for interface with the external auditors and legal counsel of the Union.

Tellers Committee

Reviews election procedures and certifies the ballot counting (should be a Washington-based committee).

Scientific and Topical Committees

Atmospheric and Space Electricity; History of Geophysics; Mineral Physics

Each of these committees deals with the specific area described; each attempts to develop its interest within AGU, to serve members through meetings and publications, and to develop appropriate external contacts.

Representatives

The Union appoints representatives to serve on a number of national committees or in connection with various other societies. Currently active are relationships with the American Association for the Advancement of Science, the PAIGH Commission of Geophysics, the Renewable Natural Resources Foundation, the U.S. National Committee on Rock Mechanics, and the U.S. National Committee for the International Union of Radio Science.

U.S. National Committee for the International Union of Geodesy and Geophysics

Every 2 years the President of AGU nominates eight persons for membership on the USNC/IUGG; of these, five are selected for service by the President of the National Academy of Science.

In Congress

Upcoming Hearings

The following hearings and markups have been tentatively scheduled for the coming weeks by the Senate and House of Representatives. Dates and times should be verified with the committee or subcommittee holding the hearing or markup. All offices on Capitol Hill may be reached by telephoning 202-224-3121.

April 4: National Science Foundation authorization hearing by the Senate Labor and Human Resources Committee, Dirksen Building, Room SD-430, 10 A.M.

April 10: Markup of H.R. 4580 by the Oceanography Subcommittee of the House Merchant Marine and Fisheries Committee to ensure that the **Coastal Zone Management** Act (P.L. 94–370) is consistent with state management plans. Longworth Building, Room 1324, 10 A.M. —*BTR*

New Marine Community

While exploring the West Florida Escarpment, a steep slope in the Gulf of Mexico several hundred kilometers off the Florida coast, the deep submergence research vessel *Alvin* chanced upon a well-developed community of marine life akin to that found 7 years ago in the eastern Pacific Ocean.

According to the Woods Hole Oceanographic Institution, which operates the submersible and its new tender, the *Atlantis II* (Eos, November 1, 1983, p. 619), the marine community contains large clams, mussels, crabs, fish, and tube worms like those found at hydrothermal vents in the eastern Pacific. While the east Pacific communities exist at spreading centers, the newly discovered group, which may stretch for almost 2 km at a depth of roughly 3200 km, lies in a passive continental margin. Also, whereas the water around the Pacific hydrothermal vents is much warmer than the surrounding seawater, the water around the new found community is apparently the same temperature as the ambient waters.

The Pacific communities are now known to survive using a life-support system called chemosynthesis that is driven by the geothermal activity at the spreading centers. The driving mechanism for the life-support system for the Gulf of Mexico population is not yet known. Specimens from the Gulf community have been collected for study. Scientists will seek to determine if the Gulf species are the same as those found in the Pacific or if they are new species. The researchers will also try to discern if hydrogen sulfide, which supports the Pacific community, also supports the new group.

The Oceanography Report

Bruce Turnbaugh

The Oceanographic Report
The forum for ocean physical, chemical, geological, and biological oceanographers.

Associate Editor Arnold L. Gordon, Lamont-Doherty Geological Observatory, Palisades, New York 10964 (telephone 914/359-2900, ext. 325)

NOAA's Service to Research

John V. Byrne

Ed. Note: The following text is excerpted from the author's remarks delivered at the AGU Ocean Sciences Meeting, New Orleans, La., January 1984.

I want to discuss two of the major areas of effort in which NOAA is engaged—service and science. There is a third area, management, where we have responsibilities for managing fisheries, marine and estuarine sanctuaries, and so on. But that is not the focus of my remarks today. I want instead to concentrate on NOAA's primary responsibility, service, and on some areas of NOAA research that underpin our service functions.

All scientists know the difficulty of keeping abreast of developments in our own disciplines. But beyond that, there is always the intriguing possibility that we can draw new ideas, methods, or technologies from other disciplines, and apply them to our own research. When we see what other kinds of research are being pursued—what the links might be with our own work—we can sometimes solve problems larger, and often more vital, than those we were initially addressing.

This type of linkage is particularly important to NOAA because of our responsibility to provide service involving the ocean, the atmosphere, and even space. (We have the responsibility of monitoring solar flares as well as operating remote sensing satellites.)

The architects of our agency must have recognized that the understanding of the ocean, its resources, and its interactions with mankind lay in better understanding of oceanography, meteorology, marine biology, economics, and human behavior—and of the linkages among all of them.

Service

Among our services to the ocean community, we are proud of those offered by the National Geophysical Data Center in Boulder, Colorado. It has a couple of groups that you should find helpful—one for geology and geophysics, and another — under contract with the University of Colorado — for glaciology. They are looking toward some interesting new projects.

One of the projects stems from President Reagan's March 10, 1983 proclamation of a U.S. Exclusive Economic Zone (EEZ). It established U.S. jurisdiction over all resources in and below the oceans out to the 200-mile limit previously established by the Fishery Conservation and Management Act, and opened up great possibilities—ultimately for economic development and more immediately for scientific exploration.

NOAA and the U.S. Geological Survey are jointly planning a cooperative survey of appropriate areas in the EEZ using the Seabeam system on the NOAA ship *Surveyor*, and perhaps another ship, to come up with the necessary maps. This is truly an interagency and interdisciplinary effort, designed to take full advantage of the possibilities opened up by the President's proclamation. In addition, NOAA will focus on the physical, chemical, and biological aspects of those parts of the ocean. (I should add also that we have two excellent seagoing systems for high-resolution, multibeam swath surveys, and we are working closely with USGS and other interested parties in planning joint use of both of them.)

The Seabeam system is a deep water system. It is used in water depths greater than 100 m, with swath widths of 0.8 times the water depth.

In addition, we have a Bathymetric Sonar Survey System—BSS. It is on the NOAA ship *Davidson* and is used in shallower waters (depths of about 10 to 600 m), with a swath width of 2.5 times the water depth. To the best of my knowledge, the BSS system is unique.

Scientists from our National Ocean Service are working with USGS scientists to plan multibeam swath surveys of appropriate areas of the EEZ, sharing the funding and cooperating in data processing and devising formats for the data. And their colleagues from our National Geophysical Data Center are also working with the USGS on an implementation plan for distributing the bathymetric information obtained from these cruises.

Of course, we also operate the National Oceanographic Data Center. I know most of you are familiar with it. If you are not well acquainted with its products and services, you'll find an exhibit and some helpful people here at this meeting.

Among NOAA's most important service responsibilities in the oceans are those providing for safe and efficient coast and marine operations. In addition to the many routine services that we offer — nautical charts, tide tables, and the like — we are working toward some new and very unusual products. They'll blend advanced technology and management techniques with traditional data presentation to provide much more up-to-date, and consequently more accurate, operational information in numerous critical areas.

One of these areas is port operations.

We live in a high tech world of electronic computers, earth satellites and space shuttles, and communications of astonishing sophistication. But some areas, such as port operations, have remained essentially low tech.

Ships do have radio, radar, and depth finders, it is true. But they are still dependent upon charts that give retrospective rather than actual data, tide tables that give predictive rather than actual data, binoculars to see and estimate the speed and direction of other traffic, and so on. Low tech, and sometimes rather inadequate.

We are thinking of some major improvements both in the technical and in the management aspects of harbor operations, aimed at making ports much more efficient places. We call this Project PORTS.

We are beginning with systems to provide real time tide and water level information to ships entering and leaving harbors. To these will be added data on currents, waves, and weather, and possibly ice information in northern latitudes.

We are also considering implementation of electronic display of digital nautical chart information. Chart information can be transmitted via telephone wire, or telemetry, or distributed in cassettes for display on cathode ray tubes aboard ship. Ultimately, perhaps, we will have an entirely electronic bridge, comparable to the instrument display in front of an airline pilot as he lets down to land.

We envision the day when a ship entering a harbor will display the appropriate nautical chart on a CRT screen on the bridge. Real time information on its exact position, channel markers, currents, and other data will also be displayed. The navigator will have a moving image of everything he needs for accurate and safe navigation under any conditions. NOAA will have a role in this, as will the local ports management and the private sector.

Devising such a system would require the talents of chart makers, oceanographers, electronics engineers, managers of ports and harbors, and many others.

We have embarked on another, more immediate program to expand our services to the ocean community, through the establishment of an Ocean Service Center in Seattle. This center integrates the products and services of all NOAA's main components.

It provides one-stop shopping, if you will, for all the information we have, both real-time, such as weather, and retrospective, such as scientific publications, data bases or nautical charts. A major purpose of forming this center is to improve the quality of our products, and speed up their delivery to users.

Seattle was selected for the first center because it is home to the largest number of NOAA employees outside Washington, D.C. — representing all our main components. If the Seattle center works as well as we think it will, it will be the forerunner of others in ports around the Nation.

The kinds of information the Ocean Service Center has available include—Atmospheric and oceanographic warnings, forecasts, and analyses; Nautical charts, tide tables, current information, and the like; Marine environmental quality information; Fish marketing statistics; marine advisory services; Information on marine mammals; Status reports on special issues such as port development, ocean outfalls, and Regional Fishery Management Plans; Information on major natural events such as El Niño; Information on major man-made events such as oilspills; Access to NOAA and non-NOAA data bases.

Among other things, the model and data base of the Naval Oceanographic Data Distribution System — which originates from the Fleet Numerical Oceanography Center in Monterey, California — is now being incorporated in NOAA marine weather forecasts.

NODDS, as it is called, provides a suite of synoptic oceanographic and meteorological information including the present situation and prognostications in ocean areas. Its data sources include hundreds of Navy and other ships, fixed and floating buoys, satellites, and many other platforms.

NOAA took over funding for the commercial and non-Navy uses of NODDS last July 1. It is a great asset to our marine weather forecasting.

We are also in the early stages of developing synoptic global forecasts for the ocean which will be operational and will be disseminated through the ocean service centers.

Our ocean Service Center will not compete with private industry. This is fundamental to our philosophy and to our way of doing things. We will cooperate with business in identifying products and services that have viable commercial markets, and that the private sector can best exploit. We will cooperate and encourage transfer to the private sector in those cases.

I have mentioned that service is NOAA's number one job, and the Ocean Service Center concept is a major effort to improve our service. We conduct a great deal of research, ranging from very applied to quite basic studies of oceans and atmosphere, but all of it is related to our missions of service. There are a number of areas closely related to your interests.

I notice that your program included a full day session yesterday on El Niño, and another Friday on the Southern Oceans, which I might conjecture bears some relationship to El Niño. NOAA has of course monitored and conducted a great deal of research on that phenomenon — as you might expect, because of what it will tell us about long-range climate effects. But we have other interests, in quite different fields. Linkages.

We have economists, in our Assessment and Information Services Center. They are most interested in the economic effects of El Niño.

And biologists. Let me tell you about their interests.

A year or so ago three groups of NOAA scientists were studying somewhat different problems out on the west coast. Marine meteorologists were tackling a problem posed by the National Weather Service for improving ice forecast models in the Bering Sea. Some physical oceanographers were studying ocean circulation in the area . . . and some fishery biologists were studying fluctuations in the king crab population there. Their problem: Why had crab production plummeted from 140 million pounds in 1978 to about five million five years later?

Fortunately, the fisheries people looked to the others for help; the results of the three studies turned out to mesh extraordinarily well.

The meteorologists found that the position of the jet stream each year has a profound effect on storm tracks in the Bering Sea — sending them far up north, or along a southerly path, which influences the extent of the ice pack.

The oceanographers found that this wind-driven system also greatly influences ocean circulation.

The fishery biologists knew that king crabs release their eggs at the bottom, and that these float to the top as larvae and then, as juveniles, take about eight years to grow to the size where they enter the fishery. The juveniles feed on the large planktonic bloom that is normally found in the relatively undisturbed warm top layer of the water.

As a multidisciplinary team, the three found that when storms hit the area, the water is thoroughly mixed, the normal large crabs have to serarch much further for food — which increases their exposure to predators. The biologists also think that the colder, more saline water is less conducive crab growth, but they don't yet know which characteristic, or combination of characteristics, is most important.

Enter El Niño.

Through the process known as teleconnection, effects of the southern oscillation that causes El Niño are transmitted to the northern hemisphere, bringing about a strong westerly flow at lower latitudes than normal. The semi-permanent low in the Gulf of Alaska is strengthened, leading to more intense disturbances whose effects are again transmitted to the ocean.

This is, of course, the change in storm paths that influence the extent of the ice pack, as I have mentioned.

The economic implications of this are tremendous. If we can know enough about these fluctuations to model them, we can predict them — far enough in advance, we hope, so that some day we will be able to give the king crab fishermen adequate warning to modify their boats to hunt another species during a season or so. All because, eight or nine years previously, the jet stream didn't follow its normal course. [o] And this of course stimulates further inquiry. The conditions that may cause a decrease in the stock of king crab may be just right to cause an increase in other species. What species? If this hypothesis turns out to be true, and if we could find out the species, then we could also advise the fishermen, so they'd know how best to rig their boats.

We do know that last year's Southern Oscillation El Niño resulted in movement of many tropical species northward, including yellowtail, bonito, and barracuda.

From February to April of last year barracuda were caught in Monterey Bay, bonito south of San Francisco, and two tropical species — pompeo caballita and Pacific hamfish — were found farther north than ever before observed.

We are continuing our studies of this problem, trying to take full advantage of all the linkages among various disciplines to address the problem of recruitment — which we are beginning to recognize as critical to the health of fish stocks. It is an area where physical scientists have much to contribute.

With respect to the climatological aspects of El Niño, an international research project — TOGA, for Tropical Ocean Global Atmosphere — is going to take place to explore the dynamics of the great ocean-air mass whence El Niño arises. It will be a decade-long experiment. The International Project Office will be established in NOAA, and field operations are scheduled to begin about January of 1985.

Additional light is being shed on the whole phenomenon of El Niño through work at our Geophysical Fluid Dynamics Laboratory. It has developed a coupled ocean-atmosphere model that simulates the amplification of modest initial perturbations during El Niño-Southern Oscillation events. The model reproduces the simultaneous growth of perturbations in the atmosphere and ocean.

A new model has also been developed there — in cooperation with the Army's Cold Regions Research and Engineering Laboratory — to study the interaction of sea-ice dynamics and the ocean circulation. It is a coupled ice-ocean model, and was tested out for the Arctic Ocean-Greenland Sea region, using winds derived from the First Global GARP Experiment to drive it.

Preliminary results allow a comparison between ice position with and without active currents in the ocean models. The effect of currents provides a much more realistic seasonal variation of ice front, as well as a simulation of the salinity gradients near the ice boundary frequently observed in polar oceans.

The growth of polar pack ice is realted both to the ambient air temperature and the strength of winds that deform the ice and control the amount of open leads and distribution of ice thickness. This coupled ice-ocean model will be carefully tested with the view of including it in a fully coupled global climate model.

One of GFDL's most important efforts is the study of climate variability by means of these coupled ocean-atmosphere mathematical models. The lab has recently completed an investigation of the transient response of climate to an increase of atmospheric concentration of CO_2. What they found was that the surface air temperatures over continents respond more quickly to an increase in CO_2 levels than does the corresponding surface temperature of the oceans, with their large thermal inertia.

NOAA is studying the oceans in many ways, from modeling to physical oceanography to biology. NOAA scientists are also going to be carrying on investigations of subsea geology, both within and outside the EEZ. This will follow up previous research on polymetallic sulfides and seafloor spreading. I've already mentioned the Seabeam work of Surveyor.

In July of this year, NOAA scientists will visit sites of active hydrothermal venting along the Juan de Fuca ridge in a series of Alvin dives. Geological, Geochemical, and biological samples will be taken.

Our Class I ship Researcher will do a multidisciplinary cruise to the Mid-Atlantic Ridge in August for bottom dredging, water sampling, and photography.

And we aim to have bathymetric and tectonic maps of the Gorda and Juan de Fuca Ridges available in September. We are attempting to coordinate our activities in this area with the USGS and, through the National Science Foundation, with academic scientists. We are making progress, but not fast enough — for you or for me.

In addition to supporting Alvin dives, we have — as many of you know — a national undersea research network, operated for us by universities and available to qualified scientists of all disciplines. Of these, Hydrolab, located off St. Croix in the Virgin Islands, is the "old man of the sea" where habitats are concerned. It has been operational for many years and has proven immensely useful.

It is, incidentally, the only operating habitat system in the free world now used for scientific purposes.

Operated for us by Fairleigh Dickinson University, Hydrolab is in 15 meterse of water, and supports four scientist-divers for a week. They can operate to depths of 50 meters, coring the reef and observing geologic and biological processes.

As part of this national network, we also support the two-man submersible Makalii operated by the University of Hawaii, and a manned open diving bell system with surface support ship operated by the University of North Carolina.

A temperate water habitat is now under construction, to be operated for us by the University of Southern California. It will house six scientists for up to 30 days, at a maximum depth of 40 meters, with capability for the divers to go down as far as 65 meters.

And a fifth part of this national network is now being developed by the University of Connecticut, in support of undersea activities off the New England coast. The group is currently considering the appropriate kind of facility for the rigorous conditions of that area.

I am sure many of you will be interested in a major workshop on the status of NOAA's undersea activities, which will be held in May at the University of Connecticut facility at Avery Point. It will focus on present and future activities in all disciplines throughout our national undersea network, and we will be inviting major players from abroad as well as U.S. scientists.

I have adverted to the EEZ a couple of times in my remarks today, and I want to mention it once more in closing, to tell you of a forthcoming event that I hope you will join me in supporting. it is the Year of the Ocean, which will begin March 10 — the anniversary of the EEZ proclamation.

The Year of the Ocean is designed to accomplish three goals — to expand public awareness and knowledge of the importance of the ocean and its resources, to promote a sense of stewardship for them, and to foster a public/private partnership for wise use and management of ocean resources.

It is being run by a nonprofit Foundation created especially for the purpose, and is being funded by donations from industry and other interested groups.

You will be hearing a great deal more about the Year of the Ocean in frothcoming weeks, as programs are put together at both national and local levels. I look forward to your active participation.

EOS

Transactions, American Geophysical Union

The Weekly Newspaper of Geophysics

For speediest treatment of contributions send three copies of the double-spaced manuscript to one of the editors named below and one copy to AGU.

Editor-in-Chief: A. F. Spilhaus, Jr.; **Editors:** Marcel Ackerman, Mary P. Anderson, Peter M. Bell (News), Bruce Doe, C. Stewart Gillmor (History), Clyde C. Goad, Arnold L. Gordon, Louis J. Lanzerotti, Robert A. Phinney; **Managing Editor:** Michael Schwartz; **News Writer:** Barbara T. Richman; **News Assistant:** Tony Reichhardt; **Production Staff:** Dae Sung Kim, Patricia Lichiello, Lisa Lichtenstein, Cynthia T. McManigal.

Officers of the Union

James A. Van Allen, President; Charles L. Drake, President-Elect; Leslie H. Meredith, General Secretary; Carl Kisslinger, Foreign Secretary; J. Tuzo Wilson, Past President; A. F. Spilhaus, Jr., Executive Director; Waldo E. Smith, Executive Director Emeritus.

For advertising information, contact Robin E. Little, advertising coordinator, at 202-462-6903 or toll free at 800-424-2488. Advertising must be informative and consistent with the scientific and educational goals of AGU and is subject to approval by AGU. Advertisers and their agents assume liability for all content of their advertisements and for any claims arising therefrom against the publisher. Offers in advertisements are subject to all laws and are void where prohibited.

Subscription price to members is included in annual dues ($20 per year). Information on institutional subscriptions is available on request. Second-class postage paid at Washington, D. C., and at additional mailing offices. *Eos, Transactions, American Geophysical Union* (ISSN 0096-3941) is published weekly by

American Geophysical Union
2000 Florida Avenue, N.W.
Washington, DC 20009

Cover. Worldwide track chart of marine geophysical data held at the National Oceanic and Atmospheric Administration National, Geophysical Data Center (NGDC), Boulder, Colo. Data collected along these tracklines include gravity and magnetic field measurements, seismic profiles, bathymetry, and sidescansonar. More than 16 million km and more than 15 million digital data records from some 28 major governmental, academic, and private research institutions worldside are covered. All data are in the public domain. A computerized inventory and data-selection system called GEODAS (Geophysical Data System) is used at NGDC to identify and retrieve requested data from the digital or analog (microfilm, seismic cross-section, etc.) files. GEODAS is an interactive data management system with graphic capability (e.g., the cover illustration). Data may be selected by geographic area, specified data parameters, collecting institution, date, cruise, and several other possible criteria. Digital data selected by GEODAS are supplied in the MGD77 exchange format on magnetic tape; microfilm and "analog" seismic profile sheets are provided as one-to-one copies of their corresponding media. Further details on the MGG77 data exchange format, GEODAS, and other NGDC data services are available from NGDC, Code E/GC3, 325 Broadway, Boulder, CO 80303. (Illustration prepared by Dan Metzger of NGDC.)

News & Announcements

AGU Ocean Sciences Award: Feenan D. Jennings

The Ocean Sciences Section of the AGU recognizes Feenan D. Jennings' 25 years of excellent service and successful leadership in the ocean sciences community. He earned the B.S. degree at New Mexico State University (1950) and pursued graduate studies at Scripps and the University of California at Los Angeles. Feenan's career in marine research management began when he left his position as Senior Engineer at the Scripps Institution of Oceanography in 1958 to become Head Oceanographer of the Geophysics Branch of ONR, a position he held until 1966. During his career with ONR, one of his additional duties was subelement monitor for basic research funds earmarked for oceanography. This important function involved monitoring, reporting and helping to defend the expenditure of all oceanographic basic research funds spent by the Navy. He was also instrumental in formulating and carrying through a ten-year ship plan which resulted in the construction of most of the large oceanographic vessels now used by the U.S. academic community.

He became Deputy Director of ONR's Ocean Science and Technology Division (1966–1970) and then joined NSF as Head of the Office for the International Decade of Ocean Exploration, a position he held until 1978. IDOE was a new approach to multi-institutional, sometimes multidisciplinary, research, and it required skill, tact, patience, and considerable force to carry it through. Feenan's work as Head of IDOE was both arduous and superb. Under his leadership, the IDOE broadened its original scientific scope to include support for projects dealing with Living Resources. While at NSF, Feenan served for one year (1975–1976) as Acting Director of the Division of Ocean Sciences in addition to his IDOE post.

In 1978, he became Director of the Texas A&M University Sea Grant College Program, one of the largest in the nation. Since 1982, he has also served as Executive Director of the Texas A&M Office of University Research Services. The Sea Grant Association elected him its President for 1981. In that capacity, Feenan provided much needed leadership in presenting and defending the national Sea Grant budget to various elements in Washington.

He has served as a member or chairman of numerous national and international committees concerned with the planning and review of marine research, including the Intergovernmental Oceanographic Commission (1970–1978), the U.S. Secretariat for US-USSR Agreement on Cooperation in World Ocean Studies (1973–1978), and the Blue Ribbon Committee of the Marine Technology Society (MTS). In 1981, he was named chairman of two committees of the National Academy of Sciences, one on Coastal Flooding from Hurricanes and the other on the DOE Regional Oceanography Review Panel. In 1983, he was appointed to the Texas Coastal and Marine Council by Governor Mark White.

Among his numerous awards and honors are the MTS Meritorious Service Award, designation as an MTS Fellow, the NSF Distinguished Service Award, Navy Meritorious Civilian Award, Navy Outstanding Service Award, Navy Superior Service Award, and the Military Oceanography Award (from the Oceanographer of the Navy).

In summary, Feenan Jennings is recognized as the "Paul Bunyan" of oceanographic research management: he had the foresight to break new ground, the integrity to seek quality in the research programs he sponsored, the wisdom to respond to the scientific community's needs and initiatives, the leadership to guide and support his program managers, and the requisite patience to deal with the tribes of principal investigators. For all of this, Feenan, accept our thanks.

For the Ocean Sciences Section:

Christopher N. K. Mooers
President

Joseph L. Reid
President-Elect

Peter G. Brewer
Secretary

January 25, 1984

California Coastal Study

Under a contract recently awarded Raytheon Service Company by Minerals Management Services (MMS), the California Coastal Current system will be investigated over a 30 month period involving 18 months of field effort.

The study, under the guidance of Sig Larson, MMS COR, located in the Los Angeles POCS, is to gather a comprehensive data base aimed at describing the mesoscale dynamics in the nearshore regions (to about 50 km offshore) where oil production and transport are most active for the near future. MMS is most anxious that the study be coordinated with any other studies of the region that will take place coincident with the MMS program. The design of the survey has been tied to the historical studies, particularly CALCOFI (California Cooperative Oceanic Fisheries Investigations), to enhance the understanding of variability within the scale of the features observed.

The study encompasses a region extending about 50 km offshore, reaching from Point Conception to San Francisco. The field effort is more concentrated in the southern portion. Between Point Conception and Point Buchon, a grid of hydro lines at 10 km intervals will have conductivity, temperature, and depth (CTD) stations at 20 km spacing with expendable bathythermograph traces (XBT's) at the midpoints to detail the mesoscale structure of the shelf waters. North of Buchon, the CTD spacing will continue at 20 km, and lines will coincide with historical CALCOFI lines. Surveys are scheduled for January, July, and October 1984 and January 1985. The intense sampling in the southern portion will be repeated twice in an 8 day period, providing two "snapshots" of a region where the changes in flow structure appear to be caused by a number of dynamic events superposed on an equatorward mean flow that varies seasonally.

Historically, studies have examined some parts of the region for description of the flow and the dynamic processes. B. M. Hickey [The California Current system: Hypothesis and facts, *Prog. Oceanogr., 8*, 191–279, 1979] has summarized these. Recent studies reported by C. N. K. Mooers [Initial results of the Optoma experiments, paper presented at the EDOC Conference, Lake Arrowhead, Calif., 1983] have described eddy structure with interfaced geostrophic "jets," Lagrangian trackers, in studies reported by R. Davis [Results of drogue tracking during code experiments, paper presented at CALCOFI conference, Idyllwilde, Calif., 1983], have seemingly been caught in very high speed (greater than 1 knot) offshore surface flows described as "squirts". The name fits the high speed, narrow, limited extent (200 km) and duration (2 days) of the features as observed by the drogue experiments. Larger scale, more permanent, nearshore, high-speed currents are a regular feature of the region epitomized by the well known Davidson Current appearing in the winter months as a poleward flowing surface feature.

Eleven mooring locations (with vector averaging current meters in the near surface levels, Anderaa meters below the near surface wave activity, and bottom pressure sensors at five moorings) will be located through the area on lines coincident with hydro survey lines. Eighteen months of data from the moored instruments will provide observation of speed/direction, temperature, and conductivity that can be interpreted in conjunction with the hydrographic cross-sectional profiles.

Lagrangian surface drifting devices will be released during each hydro survey in two modes: (1) on three standard lines along hydro-survey lines as a complement to the hydro and moored instrument data and (2) seeded in specific features that are identified from satellite imagery. Satellite imagery and 4° gridded sea surface temperatures will be acquired daily on a regular and continuing basis during the 18 month field program for the overview analysis of the surface dynamics. During tracking studies, the imagery will be analyzed in near real time to furnish direction to the seeding and tracking aircraft. With luck, the data from the hydrographic survey, the moored instruments, and the tracking efforts will combine to provide a detailed description, in space and time of the dynamic events in the intensively measured region. Additional data to be acquired as part of the study will include hourly winds, temperature, pressure, relative humidity, and diurnal wave spectra from the NDBC buoys (furnished by Global Weather Dynamics, Inc., Monterey, Calif.); hourly winds, temperature, and pressure from nearly 20 near-coastal weather reporting stations (from Global Weather Dynamics, Inc., Monterey, Calif.); synoptic reports including shoreside stations and ships of opportunity; calculated winds, wind stress, wind stress curl, Ekman drift, meridional transport on a 1° grid, derived from surface pressure distribution the calculations follow the technique of Bakun (furnished by Global Weather Dynamics, Inc., Monterey, Calif.; water level data from National Ocean Survey station locations from Oregon to the Mexican border; and historical and current CALCOFI data for the alongshore region including Santa Barbara Channel to San Francisco and offshore to the limit of the survey lines (furnished by National Marine Fisheries-Southwest, Ronald Lynn.)

Close coordination between this program and the CALCOFI program has been assured by exchange of information on survey design and schedules. This is a CALCOFI year, and a major effort involving some seven surveys between January and September will establish the large-scale structure. Overlap of the two programs occurs in the nearshore region. Further, increased effort by the CALCOFI vessel, *Jordan*, in the MMS area of interest during the March survey will fill the gap in the MMS survey schedule creating a uniform seasonal sampling pattern. Two or three of the nearshore CALCOFI stations on a number of lines will be occupied by both parties promoting comparability of the two data sets. The two programs take place in a time when the El Niño conditions may be in a declining state; thus the opportunity to capture the transition and, through comparison of the observed state to historically observed conditions, gain an exciting insight into the nature of changes induced by the El Niño, makes this cooperation doubly rewarding.

Efforts to coordinate the study with other studies or programs in the region or in bordering regions have thus far resulted in an exchange of data and results with the OPUS and Santa Barbara Channel programs. For the Santa Barbara Channel program the availability of imagery will be a benefit in operations and planning. Other investigators planning operations in the region during 1984–1985 are encouraged to contact the program management at Raytheon in Ventura to explore the benefits that may derive from a liason. Data will, of course, be available through the National Oceanic Data Center as quickly as it can be processed to meet their delivery requirements; but early access may be beneficial to investigations aimed at explicit short-lived features.

The program manager is Robert J. Tait, Raytheon Service Company, 5126 Ralston Street, Ventura, CA 93003, telephone (805) 656-2550.

This news item was contributed by Noel B. Plimpton, *Chief Scientist, Raytheon Service Company, Ventura, CA 93003.*

Classified

RATES PER LINE

Positions Available, Services, Supplies, Courses, and Announcements: first insertion $5.00, additional insertions $4.25.

Positions Wanted: first insertion $2.00 additional insertions $1.50.

Student Opportunities: first insertion free, additional insertions $2.00.

There are no discounts or commissions on classified ads. Any type style that is not publisher's choice is charged at general advertising rates. *Eos* is published weekly on Tuesday. Ads must be received in writing by Monday, 1 week prior to the date of publication.

Replies to ads with box numbers should be addressed to Box —, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, DC 20009.

For more information, call 202-462-6903 or toll-free 800-424-2488.

POSITIONS AVAILABLE

Statistician/Water Resource Research. Excellent opportunity with Wyoming Water Research Center and Department of Statistics at the University of Wyoming, to perform statistical/mathematical research, consult in parametric and non-parametric hydrology, interact with state agencies, and teach limited classes, including guidance of graduate student research. Requires a Ph.D. with demonstrated research ability in applied statistics, probability modeling and stochastic processes related to water problems. Mathematical and computer applications, i.e., simulation and programming, as well as prior consulting are also preferred. This tenure track position provides rank and salary commensurate with experience. Our location in the Medicine Bow Range of the Rocky Mountains offers abundant recreational opportunities. Write Dr. Jim Haseman, Department of Statistics, University of Wyoming, Laramie, Wyoming 82071.

An equal opportunity/affirmative action employer.

Applied Science Associates. Applied Science Associates, Inc. (ASA) is a consulting ocean engineering and sciences firm specializing in numerical modeling of shelf, coastal and nearshore processes, is seeking to add senior level positions to a rapidly growing staff. Applicants with research interests in numerical modeling of oil spill fates and impacts, ecosystem dynamics, marine and ground water hydrodynamics and pollutant transport, sediment transport, and wave dynamics of particular interest. *Applicants should submit a resume, evidence* of the ability to generate a contract-supported research program, and the names of three references to:

Dr. Malcolm L. Spaulding
Applied Science Associates, Inc.
329 Main Street
Wakefield, Rhode Island 02879.

ASA is an affirmative action/equal opportunity employer.

University of Denver/Research Positions in Space Plasma Theory. The Department of Physics invites applications for two postdoctoral research positions in plasma physics research group beginning July 1, 1984.

Postdoctoral Research Associate: The applicant must have a Ph.D. in plasma theory with strong background in kinetic theory, non-linear waves and applied mathematics. Some experience in beam plasma instabilities is preferable. Familiarity with space plasma and field observations and use of CRAY-1 useful. The position is suitable for June graduate or someone with one/two year's postdoctoral experience.

Assistant Research Professor: The applicant must have a Ph.D. in plasma theory with strong basic training in kinetic theory of plasma instabilities, numerical methods, possibly simulation techniques. Experience with space plasma and field data useful but not required. Sucessful research experience of three years beyond Ph.D. is required. This is a regular junior research position on a continuing basis dependent on annual reviews and availability of funds and carries with it usual fringe benefits. Duties include participation in current programs of applications of plasma instabilities in space, research proposal preparation and occasional student supervision.

Please send curriculum vita and names and addresses of three references to: Professor V.L. Patel, Department of Physics, University of Denver, Denver, CO 80208. Salary: Competitive and commensurate with experience and qualifications.

The University of Denver is an equal opportunity/affirmative action employer.

Faculty Position in Structual Geology/Tectonics. The Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, has an opening at the Assistant Professor level, in the area of structural geology and tectonics. We will fill this position with either a tenure track or temporary appointment beginning with the Fall 1984 term. For the temporary appointment ranks higher than Assistant could be considered. A Ph.D. is required.

The successful applicant will be expected to teach courses in structural geology, structural analysis, tectonics, and/or other areas of research interest. The tenure track appointee will be expected to develop a vigorous program of sponsored research and to direct graduate student projects.

The MEAS Department currently has 31 full-time faculty, including 12 geologists and geophysicists. Please send complete resume and the names of at least three references to: E.F. Stoddard, Search Committee Chairman, Department of MEAS, NC State University, Raleigh, NC 27695-8208; telephone 919-737-2212. Applications will be considered as received, with a closing date of May 1, 1984.

North Carolina State University is an equal opportunity/affirmative action employer.

Assistant Director/National Climate Program Office. The National Climate Program Office (NCPO), Rockville, Maryland invites applicaton for a rotating position under the Intergovernmental Personnel Act (IPA). This IPA permits temporary assignment of employees between Federal agencies and State or local governments, institutions of higher education, Indian tribal governments, the Trust Territory of the Pacific Islands, or other approved *nonprofit organizations. Employees* of a State or local government must be a permanent, career employee of that organization for at least 90 days prior to entering into a mobility assignment agreement with a Federal agency. Period of service is one year beginning October 1, 1984 with the option of a second year if mutually desirable.

The duties of the position are to review and help develop National and International Climate program plans; assist in planning, developing, and overseeing NCP project; and, advise in implementing climate related activities of the United States in bilateral projects and the World Climate Program (WCP). Candidates are sought with the following qualifications: (1) Ph.D. in meteorology or physical oceanography; (2) Experience in preparing and reviewing research plans; (3) Knowledge of activities of national *Climate Program* (NCP) and the World Climate Program (WCP) of the World Meteorological Organization (WMO); (4) Familiarity with applications of satellite data and technology to climate programs; and (5) Ability to communicate ideas through writing and oral presentations.

The NCPO under the IPA will negotiate salary, benefits and travel with the selectee's cooperating institution. A resume, three references and curriculum vae should be submitted *by May 1, 1984* to:

Dr. William A. Sprigg
NOAA/National Climate Program Office
Room 108, Rockwall Building
11400 Rockville Pike
Rockville, Maryland 20852
Telephone # 301-443-8981

An equal opportunity employer.

Trace Element Biogeochemist. The Academy of Natural Sciences' Benedict Estuarine Research Laboratory has an immediate opening for a postdoctoral scientist interested in trace metal interactions with biota and transport through estuarine ecosystems. Initial appointment is for one year, with possible extension to two years. Please call for information or submit curriculum vitae, summary of research interests and names, addresses and telephone numbers of three references to: James G. Sanders, Benedict Estuarine Research Laboratory, Benedict, MD 20612, 301-274-3134.

Howard University/Graduate Faculty Position. The Department of Geology/Geography invites applications for a tenure track position in geochemistry at rank of Graduate Associate Professor beginning August 1984. Position involves development of graduate research program at Master's level. Specialization in environmental geochemistry/geochronology/isotope geology desired. Send letter of application, resume and names of three references to: Dr. David Schwartzman, Department of Geology/Geography, Howard University, Washington, DC 20059.

Utah State University/Faculty Positions. Two research faculty/research scientist positions are available in the Department of Physics and the Center for Atmospheric and Space Sciences at Utah State University. Candidates should have a Ph.D. degree and experience in theoretical and/or experimental aeronomy and space physics. Experience in the following areas will be advantageous: experimental optical spectroscopy, theoretical modelling of the chemistry and dynamics of the stratospheric/mesospheric system; theoretical modelling of the thermosphere/ionosphere. Opportunities exist to participate in stratospheric balloon, Space Shuttle and satellite flights, in the design and fabrication of experiments, and in data analysis and theoretical modelling. The opportunity also exists for a suitable candidate *to assume program responsibilities* for a major optical remote sensing instrument. A comprehensive database of terrestrial emissions covering the extreme ultraviolet to the near infrared, and extending from the surface of the earth to the thermosphere, was recently acquired on Spacelab 1, providing significant data analysis opportunities. The group is also involved in the development of comprehensive models of the photochemistry and dynamics of the thermosphere/ionosphere/plasmasphere. It is planned to extend the modelling work to the stratosphere and mesosphere in support of balloon measurements of key radicals.

Interested persons should submit a resume and the names of three individuals who can be contacted for reference purposes to:

M.R. Torr
Department of Physics
Utah State University, UMC 41
Logan, Utah 84322

before April 30, 1984. Salary will be commensurate with experience.

The Utah State University is located in scenic northern Utah, and is an affirmative action/equal opportunity employer.

Postdoctoral Research Associate in Planetary Physics. One postdoctoral position in Planetary Physics will be available in August 1984 for one year with probable renewal for a second year. Preferred experience with problems in classical dynamics, but other disciplines related to understanding the current state, origin and evolution of the solar system will be considered. Applicants should send resumes and arrange to have three letters of recommendation sent to: Stanton J. Peale, Department of Physics, University of California, Santa Barbara, CA 93106. Position will be open until filled.

The University of California is an equal opportunity/affirmative action employer.

Instrumental Analyst/UCSC. (Staff Research Associate III, Job# 84-0513) Fulltime permanent. Duties: Management of automated XRF Spectrometry Lab. Duties include equipment maintenance, joint responsibility for calibration and quality control, system development and instruction of users. Opportunity exist for personal research. Requires BS in natural science and two years relavent experience or MS in spectroscopy theory and programming experience desired; knowledge of XRFS and FORTRAN preferred. Salary $1,860 per *month*. *Apply by May* 1, 1984 to: University of California, Santa Cruz, Personnel Department, 102 Communications Building, Santa Cruz, CA 95064.

Computer Programmer/North Carolina State University. Extension Specialist in Biological and Agricultural Engineering. M.S. degree preferred, B.S. required. Position requires strong experience in computer programming and data base management in addition to a working knowledge of statistics. Ability to program in a structured language and experience with SAS preferred. The person selected will interact with engineering faculty to build and analyze a data base on water quality programs nationwide. Salary range $20,000–$25,000 based on experience. Send resume and the names of three references by April 15, 1984 to:

Dr. Michael D. Smolen
National Water Quality Evaluation Project
North Carolina State University
Raleigh, NC 27695-7637
(919) 737-2346

North Carolina State University is an equal opportunity/affirmative action employer.

NATIONAL SCIENCE FOUNDATION (NSF)

NSF's Division of Ocean Sciences is seeking qualified applicants for the position of Assistant/Associate Program Director for the Ocean Dynamics Program. The position is excepted from the competitive civil service and will be filled on a one- or two-year rotational basis. The per annum salary ranges from $30,000 to $45,000 for the Assistant Program Director and $35,000 to $55,000 for the Associate Program Director. The Program provides support *for research in physical oceanography.* The incumbent is involved in program planning and budgeting, proposal evaluation, administration of research grants, and liaison with other Federal agencies. Applicants should refer to Announcement No. EX 84-35 EOS when submitting resumes to the National Science Foundation, Personnel Administration Branch, Rm 212, 1800 G St., NW, Washington, D.C. 20550 Attn: Catherine Handle. For further information call 202-357-7840. Hearing impaired individuals should call: TDD 202-357-7492

NSF is an Equal Opportunity Employer.

Geophysical Fluid Dynamicist/Aeronautical Research Associates of Princeton, Inc. A Princeton-Based Research Corporation has a challenging position open at the Ph.D. experience level in Geophysical Fluid Dynamics, Physical Oceanography, Meteorology, or Engineering with strong background in computational Fluid Dynamics. The successful candidate will have demonstrated expertise in at least two of the following areas: Modeling of Current, Wave, and Sediment Transport in Coastal, Estuarine and Shelf Waters; Development and Application of Three-Dimensional Numerical Model of Dynamics of Atmospheric Phenomena of Meso- or Smaller Scale; Modeling of Turbulent Transport. We offer a creative work environment, excellent benefit package, and salary commensurate with experience. Send resume in complete confidence to Alexandria Lurer, Aeronautical Research Associates of Princeton, Inc., P.O. Box 2229, Princeton, NJ 08540.

An Equal Opportunity-Affirmative Action Employer M/F.

Faculty Position/University of Montana. The Geology Department of the University of Montana is inviting applications to fill a temporary, one-year position at the Assistant Professor level (contract will be from mid September 1984 to early June 1985). This position involves replacement of a faculty member on sabbatical leave. Ph.D. in geology is preferred; however, M.A.'s with teaching or professional experience will be considered. Students planning to complete their Doctorate during the 1984-85 academic year are encouraged to apply. Teaching responsibilities include undergraduate courses and introductory geology, mineralogy, petrology, sedimentology, and a seminar in area of special interest.

Those interested should send a letter of application, resume, three letters of recommendation to: Arnold J. Silverman, Chairman, Department of Geology, University of Montana, Missoula, MT 59812. The DEADLINE for applications is May 15, 1984.

The University of Montana is an affirmative action/equal opportunity employer.

Senior Research Associate. The Center for Aeronautic and Space Information Sciences at Stanford University is seeking applications for the position of Project Director. Candidates should have considerable managerial experience with space related systems and be familiar with advanced computer system technologies and their application to NASA space flight programs. Center activities include the development of local area networks, network virtual graphics, database studies, computer concurrency, video data processing and presentation, the development of remote scientific operation centers, and other NASA-related topics.

To apply, send a resume and with names of three references to: Ms. Harriet Smith, STAR Laboratory/SEL, Stanford University, Stanford, CA 94305

Stanford University is an equal opportunity and affirmative action employer.

Lecturer/Department of Physics, Boston College. Department seeks person to teach courses in the areas of space physics and introductory physics, conduct research in solar wind including data analysis and theoretical research, and supervise physics *department computer facilities.* Position requires Ph.D. in Physics or Astronomy with strong background in space physics and heating of solar wind due to interstellar neutral hydrogen, and ability to analyse large data sets using mainframe computers. Salary commensurate with experience. If interested in and qualified for this position, send resume, by April 27, 1984 to:

Professor R.A. Upham, Chairman
Department of Physics
Boston College
Chestnut Hill, MA 02167

Air Force Geophysics Laboratory Graduate Scholar Program (1984–1985). The Air Force Geophysics Laboratory (AFGL) and The Southern Center for Electrical Engineering Education (SCEEE) announce that applications are invited for research appointments during the 1984-1985 academic year in the Graduate Scholar Program. This program provides research opportunities of 10 to 12 months duration for selected Engineers and Scientists to perform research in residence at the AFGL location AFB, near Boston, Massachusetts. Scholars will be selected primarily from such fields as Geophysics, *Atmospheric Physics, Meteorology,* Electronics, Applied Science, Mathematics, Solid State Chemistry, and Engineering.

To be eligible, candidates must have a Master's or equivalent experience in an appropriate scientific or engineering field. Some appointments may be made as early as August 1984 so early application is encouraged. All qualified applicants will receive consideration without regard to race, color, religion, sex, or national origin. Application Deadline: April 15, 1984. Appointments Announced: May 15, 1984. Stipend: $2,000 per month. Travel allowance for relocation and applicable travel. Contact: Graduate Scholar Program, Massachusetts Avenue, Bedford, MA 01731, phone: (800) 323-6141 (in Massachusetts call collect (617) 861-2360). SCEEE supports Equal Opportunity Employment.

The University of Texas at Dallas/Postdoctoral Openings. The University of Texas at Dallas occasionally has postdoctoral openings in the Physics Program. Current research areas include: XUV Lasers and Laser Spectroscopy (C. B. Collins and C. D. Cantrell), Space Plasma Physics (W. B. Hanson and W. J. Heikkila), Space Optics (B. A. Tinsley, Cluster Ion Studies (*A. J. Cunningham*), Solid State Physics (R. Glosser and R. Chaney). Stipends are competitive. Interested applicants should send vita finish citizenship and ethnicity for Affirmative Action Statistical purposes is requested but not required), and names of three references to: Physics Department, UT-Dallas, P.O. Box 830688, Richardson, TX 75080-0688.

UT-Dallas is an Affirmative Action/Equal Opportunity Employer.

Staff Position/Department of Terrestrial Magnetism. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington invites applications for a staff position in geochemistry. Applicants should have a demonstrated ability for active and productive independent research using trace-element and/or isotopic techniques to investigate the origin and geochemical evolution of the solid earth.

Applicants should send a resume and have three letters of reference forwarded by May 15 to:

Geochemistry Staffing Committee
Department of Terrestrial Magnetism
5241 Broad Branch Road, N.W.
Washington, D.C. 20015

Starting time for the appointment is flexible though a target date of late 1984 is preferred.

Carnegie Institution of Washington is an equal opportunity, affirmative action employer.

POSITIONS WANTED

Plasma Physicist. Ph.D. 1979 seeking research or *teaching position. Experience in* wave-wave, wave-particle interactions, radio emission from sun and planetary radio emissions. Good working knowledge of UNIVAC and IBM computers. Box 922, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

STUDENT OPPORTUNITIES

Howard University/Graduate Assistantships in Geosciences. Howard University in Washington, D.C. offers a new graduate program for the M.S. degree in Geoscience, made possible by a grant from the Gulf Oil Company. Areas of specialization are field geology/geophysics, geochemistry, and meteorology/hydrology with remote sensing. Some stipends and assistantships are available. Interested students should write to Dr. Eric Christofferson, Department of Geology and Geography, Howard University, Wash., D.C. 20059.

GEOPHYSICIST

Faculty position in Seismology/New Mexico Tech. New Mexico Institute of Mining and Technology invites applications for a tenure-track position in Seismology at the Assistant Professor level. The PhD is required. The position is a joint appointment with the College Division and the Geophysical Research Center in the Research and Development Division. New Mexico Tech has had instructional and research programs in Geophysics for 3 decades, and confers BS, MS, and PhD degrees in the field of Geophysics. Much of the geophysical research has been, and continues to be, related to the determination of the physical characteristics of the Rio Grand Rift a major continental rift in which Tech is located. We currently operate a 14 station seismograph network (jointly with the U.S.G.S.), as well as a 3-component long-period station. In addition, studies of the crustal and upper-mantle structure are underway with portable seismograph systems using both earthquake and explosive sources. The geophysics staff and instructional program are part of the 16-member Geoscience Department, which also includes the disciplines of Geology, Geochemistry and Hydrology. The instructional and research activities of the Geoscience Department are strengthened substantially by professional *staff in the New Mexico Bureau of Mines and* Mineral Resources, and by support groups in the Research and Development Division. In addition, several of the Tech staff have collaborative research projects with personnel from the nearby Sandia National Laboratory (Albuquerque) and Los Alamos National Laboratory. Send letters of application, resume, and a brief description of teaching and research interests to: Allan R. Sanford, Geosciences Department, New Mexico Tech, Socorro, NM 87801.

Equal Opportunity/Affirmative Action Employer.

Meetings

Announcements

Hydrology Days Update

The AGU Front Range Branch "Hydrology Days" symposium will be held April 24–26, 1984, at Colorado State University in Fort Collins, Colo. (*Eos*, November 22, 1983, p. 950.)

A total of 85 student and professional papers have been selected for presentation on such topics as sand transport over cobbles; modeling the hydrology of flat, high water-table watersheds; mass transport in overland flow; catchment infiltration models from mathematical soil physics; computer simulation of the movement of water and salt in a hillslope; changes in hydrologic regimen of a disturbed watershed due to reforestation; the role of water quality in impact assessments; and augmenting reservoir yields using interbasin transfers.

A number of luncheon and banquet talks are also scheduled. John Breitcheoft of the U.S. Geological Survey (USGS) will speak on the subject of "Water Management: Who are the Managers?" at a luncheon on the meeting's first day. On day two there will be another luncheon talk (speaker to be announced) and a banquet speech by Robert C. Averett of USGS on "Hydrologic Research: Meeting Future Needs."

For more information, a complete program, and registration materials, contact Lt. J. Morel-Seytoux, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523; telephone: 303-491-5148.)

Meeting Report

1984 Ocean Sciences Meeting

Attendees at the 1984 Ocean Sciences Meeting found New Orleans to be a very hospitable, convenient, and delightful city to hold a conference, and the Fairmont Hotel to be an excellent meeting facility. There were 1100 attendees with a little over 700 papers presented. Change to the program and additional, late, and revised abstracts are printed below.

Papers Not Presented

11E-02, T. L. Clarke et al.; 11F-06, C. B. Officer et al.

12A-01, R. J. Gibbs and L. Konwar; 12A-10, S. M. Pelowski and D. T. Long; 12C-06, G. J. Warren; 12D-02, C. Stallings and J. G. Rueter, Jr.; 12D-10, S. L. Shiff et al.; 12E-01, M. Weydert and F. N. Spiess; 12E-15, C. E. Denham; 12F-09, C. S. Smyth and R. W. Sternberg.

21A-11, D. J. Terrell and J. G. Mitchell; 21B-02, J. R. Strickler and E. C. Hing Fay; 21C-03, P. Cloersen and P. S. Schopf; 21D-08, R. P. Stumpf; 21E-06, F. D. Carsey and G. G. Pihos.

22A-08, T. S. Bianchi et al.; 22C-09, D. Blasco et al.; 22E-09, E. Swift et al.; 22F-04, P. Stegmann et al.

31C-01, W. G. Harrison and L. R. Harris; 31C-07, W. K. W. Li; 31D-05, D. W. Blake; 31D-10, C. M. Seay and J. D. Thompson; 31E-01, C. A. Hagley and C. R. Goldman; 31E-04, J. C. Zieman et al.; 31F-15, R. H. Bourke et al.

32D-15, D. F. Williams and R. H. Fillon; 32D-17, M. A. Chartock.

41B-07, D. Deibel; 41C-14, R. Weyer and P. Cornillon; 41D-05, R. W. Flint; 41D-06, U. Ronner.

42A-06, E. Ozturgut; 42A-08, R. C. Tyce and P. J. Fox; 42A-13, Z. Qian et al.; 42B-12, K. M. Bailey et al.; 42B-15, V. G. Wespestad; 42F-03, B. M. Leshi.

51A-01, D. A. Stow; 51A-13, P. Schlosser et al.; 51A-14, D. J. Piepgras and G. J. Wasserburg.

52C-04, C. S. Weiler; 52C-10, J. La Roche; 52C-12, R. A. Hough et al.; 52D-04, R. E. Wilson and K-C Wong; 52D-05, D. G. Redalje et al.; 52D-08, G. S. E. Lagerloef and G. A. Cannon.

Late and Revised Abstracts

11B-17

Variability of Physical and Chemical Properties Along a Western Atlantic Oceanographic Section (24°-33°N, 70°W) During April, 1977

CURTIS C. BOHLEN (Evans-Hamilton, Inc; Seattle, WA 98125)

Water properties (temperature, salinity, oxygen, light attenuation, silicate, phosphate, nitrate, tritium) were measured along 70°W between 24°-33°N during April, 1977. Maps of the 18°C, 20°C, and 22°C isotherm depth in the Gulf Stream recirculation zone, show that the section intersected a very-core eddy (200 km diameter) containing a water mass of nearly normal 10^{14} water. In the vicinity of the eddy the Gulf Stream Return Flow was locally intensified as a strong isotherm slope; the slope was coherent between the water mass and the sea floor, and its volume transport equalled a large fraction of historical estimates for the Return Flow. Fluctuations (anomalies) of water properties were examined on isopycnals. The ratio (R) of anomalous signal to measurement error varied with water property and position in the water column. The highest ratios were: seasonal pycnocline, salinity (R = 19); 18° water, nitrate (R = 9); main pycnocline, silicate (R = 10); North Atlantic Deep Water, silicate (R = 5); and Antarctic Bottom Water, silicate (R = 10). Strong anomalies were found throughout the water column including: many anomalies of various properties concentrated in a vertical band in the upper 2 km of the ocean; a nutrient anomaly in the strong isotherm slope between temperatures of 10°C–20°C; and a small thermostad (200 m x 30 km) sandwiched in the main thermocline and a thermostad in the Antarctic Bottom Water having a dynamic signal in the lower half of the water column. The origins of selected anomalies were estimated to be at distances of several thousand kilometers from the oceanographic section.

11B-15

Physical and Numerical Parameter Dependencies in Dam Break Simulations

R.D. Nehrkorn (Sandia National Laboratories; Albuquerque, New Mexico)

Several series of numerical experiments using the Harvard Square Tessel are described. Many wave simulations over a range of spatial and temporal resolution parameters have been carried out to characterize the model's numerical stability, a study of the effect of adopted values of different coarse and fine frequency of application is also presented. The stability relationship was literally tested and used to investigate the physical parameter dependency in physically realistic simulations. The physical parameters varied are the non-dimensional B-Rossby number and mean advection.

11B-17

Evolution of Sea Surface Temperature Patterns for POLYMODE during the Winter of 1977-1978 based on Satellite and Ship Data

GEORGE A. MAUL and NICHOLAS J. BRAVO (NOAA, Atlantic Oceanographic and Meteorological Laboratory, Miami, Florida 33149)

Thermal infrared data from the Geostationary Operational Environmental Satellite were used to derive sea surface temperatures to produce maps at ten day intervals. Extensive cloudiness during December 1977, January and February 1978, caused numerous areal data gaps, and limited the accuracy to 1.3 K. A composite mean map for the ninety day period reproduces the Gulf Stream and the subtropical convergence; standard deviation about the mean shows variability in agreement with the POLYMODE eddy field. Ten day composite maps using GOES data only are usually too gappy to be objectively contoured. Combining the satellite and ship temperature into ten day composite maps would considerably improve the coverage and produce maps more in concert with the low frequency variability documented in the area by other measurements.

11F-19A

Meteorology in Lower Tropopause: A Case Study of Clear-Air Turbulence Encounter

M. Ray Peterson (Graduate School of Oceanography, Univ. of Rhode Island, Narragansett, RI 02882)
S. W. Bloom (Graduate School of Oceanography, Univ. of Rhode Island, Narragansett, RI 02882)

Weekly [illegible] of the tropopause [illegible] day of the [illegible] have taken over [illegible] Variability has little evidence for long term change in mean [illegible] trade, altitude and [illegible] and Antarctic Bottom Water, altitude (R = 10); strong anomalies were found throughout the water column including: many anomalies of various properties concentrated in a vertical band in the upper 2 km of the ocean; a nutrient anomaly in the strong isotherm slope between temperatures of 10°C–20°C; and a small thermostad (200 m x 30 km) sandwiched in the main thermocline and a thermostad in the Antarctic Bottom Water having a dynamic signal in the lower half of the water column. The origins of selected anomalies were estimated to be at distances of several thousand kilometers from the oceanographic section.

Meetings (cont. on p. 134)

Meetings (cont. from p. 133)

[illegible]

GAP

Meteorology

3715 Chemical composition and chemical interactions
Sulfur Dioxide in Remote Oceanic Air: Cloud Transport of Reactive Precursors
Robert B. Chatfield (National Center for Atmospheric Research, Boulder, CO 80307, USA). Paul J. Crutzen

Reactive surface emissions of reduced sulfur gases can produce SO_2 in the middle and upper troposphere at the levels of 80±30 pptv measured high over the remote oceans. We present simulations with a two-dimensional "Staubsauger" or "vacuum-cleaner" model that combines a photochemical model with a description of vertical transport of trace species by convective clouds within larger synoptic circulations. Emissions of 20-60 Tg(S)/yr of $(CH_3)_2S$, H_2S, or CS_2 may produce the observed SO_2. Roughly equal production rates of SO_2 and methane sulfonic acid may be expected. The amount and exact vertical distribution of the SO_2 produced remain uncertain: the greatest chemical uncertainties are the reaction yield of SO_2 expectable under clean tropospheric conditions and also the liquid-phase removal of SO_2, and the oxidation rate. The amount of upper-tropospheric SO_2 produced depends substantially on the proximity of strong reduced *S* sources to regions of active convection. However, the character of the solutions we present is invariably distinctly different from those obtained with one- or two-dimensional models employing the eddy-diffusion hypothesis.

The results of the model point beyond its original conception, and stress the likely importance of the rainy tropical jungles and mid-latitude industrial regions, since both regions have large sulfur emissions and frequently active cumulonimbus convection. This source, however, should contribute mainly to upper-tropospheric SO_2. Other chemical implications are that tropospheric *OH* may depend critically on hydrogen peroxide levels as well as the hydrocarbon and nitrogen oxide cycles. Cloud transport may play an important role in these cycles. The hydroxyl radical concentration depends as much on assumptions regarding *HOOH* reaction and transport as it does on *NO* levels.
J. Geophys. Res., D, Paper 4D0378

3715 Chemical composition and chemical interactions
PHOTOCHEMISTRY OF A REMOTE MARINE STRATIFORM CLOUD
W.L. Chameides (School of Geophysical Sciences, Georgia Institute of Technology, Atlanta, Georgia 30332)

The coupled gas- and aqueous-phase photochemistry of a stratoform cloud in a remote region of the marine atmosphere is investigated with a time dependent box model. Both scavenging of ambient acidic aerosols and gases as well as aqueous-phase chemical reactions within droplets are found to be important sources of acidity to cloudwater and can lead to pH levels in cloudwater in the remote marine atmosphere well below 5.6. The major sources of acidity via aqueous-phase chemical reactions are the generation of sulfuric acid from dissolved SO_2 and the generation of formic acid from dissolved formaldehyde. In both cases aqueous-phase free radicals can play a significant role either by directly oxidizing dissolved SO_2 and HCHO or indirectly by producing the aqueous-phase oxidant H_2O_2. The rate of SO_2 conversion to sulfuric acid is sensitive to a variety of parameters including the accommodation or sticking coefficient for SO_2, H_2O_2, HO_2, and OH, the liquid water content, and the ambient levels of SO_2, HNO_3, and other acidic or basic gases. Because high levels of SO_2 tend to deplete cloudwater of H_2O_2, the possibility exists that the pH of precipitation in polluted regions will respond non-linearly to reduced SO_2 emissions.
J. Geophys. Res., D, Paper 4D0377

Oceanography

4705 Boundary layer and exchange processes
THE SEASONAL VARIATION OF THE MIXED LAYER AND THE PYCNOCLINE UNDER POLAR SEA ICE
P. Lemke (Max-Planck-Institut für Meteorologie, Bundesstr. 55, 2000 Hamburg 13, FRG) and T. O. Manley

A model of the seasonal variation of the mixed layer and the pycnocline under polar sea ice is compared with observations during the Arctic Ice Dynamics Joint Experiment (AIDJEX) 1975 – 1976. The model is of the Kraus-Turner type extended to include mixed layer and pycnocline. The forcing mechanisms are the mechanical mixing due to ice-keel stirring and the surface buoyancy flux due to melting and freezing of sea ice. The model is designed to be used for climate studies in conjunction with atmospheric and oceanic GCM's and with sea ice models.
J. Geophys. Res., C, Paper 4C0298

4713 Circulation
A NOTE ON "PHYSICAL OCEANOGRAPHY OF THE GULF OF MAINE" BY HENRY B. BIGELOW (1927)
D. G. Mountain (Northeast Fisheries Center, Woods Hole, Massachusetts, 02543)

The circulation pattern proposed by Bigelow (1927) included a major current of water flowing southward off the southern side of Georges Bank. This pattern is not consistent with recent long-term current measurements that show the water there moves westward along the bank isobaths. The measurements made by Bigelow are reviewed to show that a Gulf Stream ring was located south of the bank during his observations and that the ring was likely entraining water off of Georges Bank, consistent with Bigelow's conclusions. (Circulation, Georges Bank, Gulf Stream rings).

J. Geophys. Res., C, Paper 4C0438

Journal of Geophysical Research

Volume 89 Number D2 April 20, 1984

Particles and Fields— Interplanetary Space

5310 Cosmic Rays
RADIAL GRADIENT OF COSMIC RAY INTENSITY FROM A COMPARATIVE STUDY OF DATA FROM VOYAGERS 1 AND 2 AND IMP-8
D. Venkatesan (Department of Physics, University of Calgary, Calgary, Alberta, Canada), R. B. Decker and S. M. Krimigis

[illegible]

Particles and Fields— Magnetosphere

5715 Electric fields
ISEE 1 AND 2 OBSERVATIONS OF AN OSCILLATING OUTWARD MOVING CURRENT SHEET NEAR MIDNIGHT
T. J. Kelly (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024), C. T. Russell and R. J. Walker

An outward moving current sheet is examined with the ISEE 1 and 2 magnetometers. It is found that the current sheet is moving outwards with a velocity of about 17 km/sec, a thickness of about 1300 km, and with the current flowing into the ionosphere. Oscillations observed in the magnetic field profile indicate the presence of a wave traveling along the current sheet from midnight towards the east with a velocity of 400 km/sec. The oscillations of the plasma normal to the current sheet associated with this wave are sufficient to explain the amplitude of the electric field oscillations in the plane of the current sheet observed by the UCB electric field detector. In addition a strong electric field is observed normal to the sheet, corresponding to a flow along the sheet of 400 km/sec, which is consistent with the velocity of the wave deduced from the intersatellite timing of the oscillations. Thus the wave is stationary in the frame of the current sheet plasma. This oscillating current sheet model explains the observed behavior of both the magnetic and *electric field observations. The potential drop across* the current sheet was very large at this time, 41±26 kV, and is comparable to the total normal potential drop across the polar cap. (Field-aligned currents, electric fields, Pi 2, substorms).
J. Geophys. Res., A, Paper 4A0223

5736 Magnetic tail
FAST MOVING PLASMA STRUCTURES IN THE DISTANT MAGNETOTAIL
M. Scholer (Max-Planck-Institut für extraterrestrische Physik, 8046 Garching), G. Gloeckler, B. Klecker, F.M. Ipavich, D. Hovestadt and E.J. Smith

We report in this paper for the first time the detailed time behaviour of the intensities and the angular distributions of energetic protons and electrons in the distant magnetotail of the earth at ~ 220 R_E and ~ 110 R_E. The data have been obtained by the Max-Planck-Institut/University of Maryland sensor system on ISEE-3 during the spacecraft's first deep tail passage. Three energetic particle bursts are studied in detail. At the beginning of these bursts we first observe streaming electrons at an energy of 75-115 keV. These are followed after several minutes by anisotropic protons. The protons exhibit an energy dispersion with higher energy protons (~120 keV) appearing before lower energy (~32 keV) protons. In two of the three cases the streaming electron distributions are followed after 8-15 min by an isotropic electron distribution. At the rear side of the bursts the time dispersion effects are not seen in reverse order. Also no gradient anisotropy effects are observed in the beginning of the proton streaming. We suggest that the satellite encounters detached plasma structures evidenced by the isotropic electrons. These structures, probably plasmoids, move with high velocities (~ 800 km/s) down the tail. The energetic electrons and protons stream ahead of these fast tailward moving plasma structures, what leads to the various time dispersion effects. This allows, in principle, a determination of the source distance from the satellite.
J. Geophys. Res., A, Paper 4A0454

5755 Plasma instabilities
DIRECT GENERATION OF THE AURORAL KILOMETRIC RADIATION BY THE MASER SYNCHROTRON INSTABILITY: PHYSICAL MECHANISM AND PARAMETRIC STUDY
D. Le Quéau and R. Pellat (Centre de Physique Théorique, Ecole Polytechnique, 91128 Palaiseau-Cedex, France), A. Roux (Centre de Recherches en Physique de l'Environnement, CNET, 92131 Issy-les-Moulineaux, France)

Recent observations at low altitudes made in the source region of the auroral kilometric radiation (AKR hereinafter) strongly support the maser synchrotron instability (MSI) as the relevant generation process for the AKR. This was first realized by Wu and Lee (1979). In a recent work [Le Quéau et al. (1983) hereinafter called reference 1] we have proposed an analytical treatment of the MSI. The present work is a continuation of this analytical study. First we investigate the physical process of the MSI, and simple analytical expressions, valid for any distribution functions of nonthermal electrons are given. It is shown that supraluminous X mode waves ($\omega/k_\parallel c \gg 1$) can resonate with relatively low energy electrons provided that the cold plasma parameters, [illegible]